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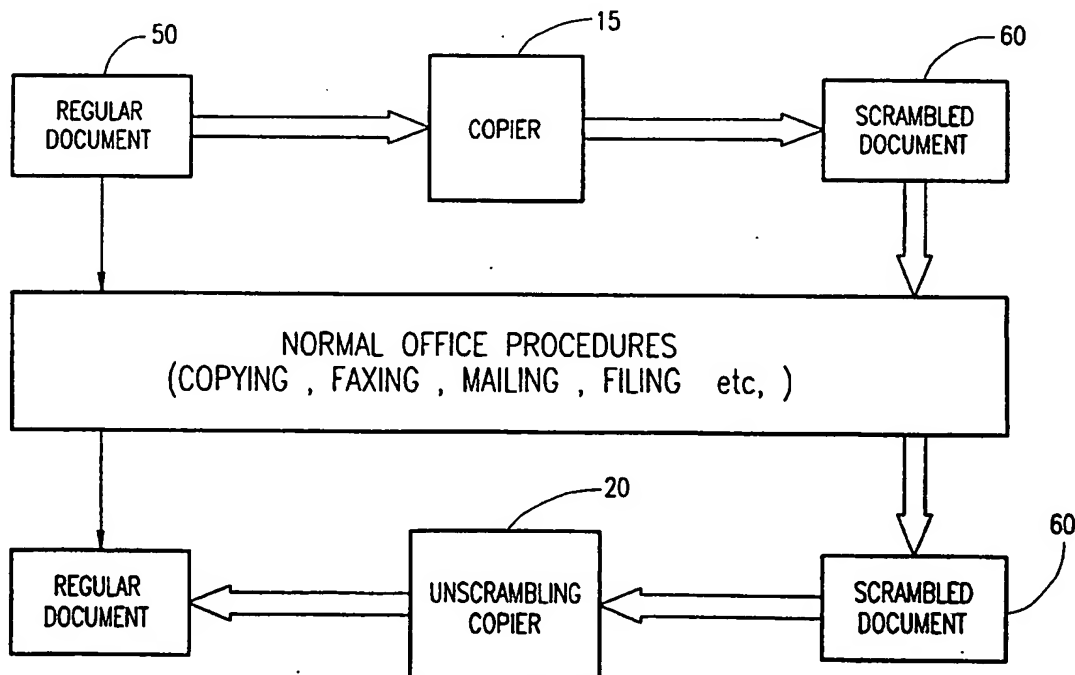
(57) Abstract

Apparatus for scrambling documents which includes apparatus for providing output signals representing the contents of a document (15), apparatus for operating on the output signals to produce modified output signals representing a scrambled version of the document (60) and writing apparatus receiving the modified output signals and producing a scrambled version of the document.

1   APPARATUS· FOR SCRAMBLING AND UNSCRAMBLING DOCUMENTS

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6   The present invention relates to creation and
7   transmission of confidential documents.

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10   There has long existed a need for secure
11   handling of confidential documents. It is well known to
12   protect information for transmission along unprotected
13   channels by scrambling or enciphering the information
14   upon transmission and unscrambling or deciphering the
15   information upon receipt, using a common secret key
16   which is known both to the transmitter and recipient.
17   Modern telefax machines such as the NTTFAX-43
18   of NTT, Japan, offer protection for confidential
19   transmissions by locking confidential transmitted
20   messages in the receiving machine and releasing them
21   only in response to an appropriate access code which
22   identifies the intended recipient.

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24   Automatic scrambling systems for documents
25   are described, for example, in "A confidential message
26   handling facility for facsimile communication" by
27   Tominaga et al, in Transactions of the Institute of
28   Electronics and Communication Engineers of Japan, Nov.
29   1982, the disclosure of which is hereby incorporated by
30   reference. In such systems, scrambling is carried out
31   on electrical signals bearing the confidential
32   information. Once the document appears in a hard-copy
33   format, it is no longer protected.

34   In summary, the prior art does not permit
35   confidential handling of confidential documents in
36   hard-copy format in a normal office environment.

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3   The present invention seeks to provide
4 improved apparatus for handling confidential
5 information in hard copy format.
6   There is thus provided in accordance with a
7 preferred embodiment of the present invention apparatus
8 for scrambling documents including:
9   apparatus for providing output signals
10 representing the contents of a document;
11   apparatus for operating on the output signals
12 to produce modified output signals representing a
13 scrambled version of the document;   and
14   writing apparatus receiving the modified
15 output signals and producing a scrambled version of the
16 document.
17   There is also provided in accordance with a
18 preferred embodiment of the present invention apparatus
19 for unscrambling documents including:
20   a scanner receiving a document to be
21 unscrambled and providing output signals representing
22 the contents of the document;
23   apparatus for operating on the output signals
24 to produce modified output signals representing a
25 unscrambled version of the document;   and
26   writing apparatus receiving the modified
27 output signals and producing a unscrambled version of
28 the document.
29   In accordance with a preferred embodiment of
30 the present invention the apparatus for operating is
31 controlled by a coded input to provide a selected one
32 from a plurality of possible modifications to the
33 output signals.
34   Additionally in accordance with a preferred
35 embodiment of the invention, the apparatus is embodied
36 in a photocopier.
37   Further in accordance with a preferred
38 embodiment of the invention, the apparatus is embodied

1 in a telefax.

2   Additionally in accordance with a preferred
3 embodiment of the invention, the apparatus is embodied
4 in a computer.

5   Additionally in accordance with a preferred
6 embodiment of the present invention the apparatus for
7 operating is operative to change the relative positions
8 of multi-pixel regions of a document, without modifying
9 the information content within each of the multi-pixel
10 regions.

11   Further   in accordance with a   preferred
12 embodiment of the present invention, the apparatus for
13 operating is operative to leave unchanged certain
14 predetermined regions of the document.

15   Additionally in accordance with a preferred
16 embodiment of the present invention, the apparatus for
17 providing includes a scanner receiving a document to be
18 scrambled and providing output signals representing the
19 contents of the document.

20   Further   in accordance with a   preferred
21 embodiment of the invention, verification of correct
22 unscrambling is provided. Such verification may be
23 carried out by the use of a registration area in the
24 document or by edge correlation operations on adjacent
25 scrambled pixels.

26   Throughout the specification and claims, the
27 term "scrambling" is used in an extremely broad sense,
28 to include any suitable reordering of the information
29 in the document. Scrambling may include encryption, but
30 need not involve encryption.

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3   The present invention will be more fully
4 appreciated from the following detailed description,
5 taken in conjunction with the drawings in which:
6   Fig. 1 is a generalized illustration of
7 apparatus for creating and transmitting scrambled
8 documents constructed and operative in accordance with
9 a preferred embodiment of the present invention;
10   Fig. 2 is a generalized illustration of
11 "paper flow" in accordance with a preferred embodiment
12 of the present invention;
13   Fig. 3 is a block diagram illustration of the
14 use of a digital copier in a preferred embodiment of
15 the present invention;
16   Fig. 4 is an illustration of one embodiment
17 of document scrambling useful in accordance with the
18 present invention;
19   Fig. 5 is an illustration of the utilization
20 of edge correlation in unscrambling a document in
21 accordance with a preferred embodiment of the present
22 invention.

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2   Reference is now made to Fig. 1, which is a

3 generalized illustration of apparatus for creating and

4 transmitting scrambled documents constructed and

5 operative in accordance with a preferred embodiment of

6 the present invention. Ordinary, conventional office

7 machines, such as a computer printer 10 and a

8 typewriter 12 may provide a hard copy document, which

9 alternatively may be handwritten. The document is

10 readable by any person without required authorization

11 and is normally human-readable.

12   In accordance with a preferred embodiment of

13 the present invention, the hard copy document is

14 provided to a scrambling copier 15, preferably a

15 modified version of a digital copying machine such as a

16 Canon 8580, which is capable of scanning hard copy

17 documents into its memory and then printing them to

18 make copies. In accordance with a preferred embodiment

19 of the present invention, the digital copying machine

20 is modified to scramble the contents of the hard copy

21 document which is stored in its memory in accordance

22 with a predetermined scrambling protocol, an example of

23 which is described hereinbelow.

24   Alternatively, a computer generated document

25 may be transmitted directly from a computer 16 via an

26 electronic fax machine 18, such as a fax modem, which

27 generates a readable document which is supplied to the

28 scrambling copier 15.

29   As will be described hereinbelow, the

30 scrambling copier 15 provides a scrambled hard copy

31 document, which can be handled in any conventional

32 office procedure, such as copying, filing, mailing and

33 faxing, without having the information contained

34 therein disclosed to an unauthorized reader. An

35 authorized reader can, at any time, take the scrambled

36 document, or a copy thereof and "copy" it on an

37 unscrambling copier 20 and thus turn it into an

38 ordinarily, human readable document.

1   Unscrambling copier 20 is preferably a
2   digital copying machine such as a Canon 8580, which is
3   capable of scanning scrambled hard copy documents into
4   its memory and then printing them to make unscrambled,
5   preferably human readable, copies. In accordance with a
6   preferred embodiment of the present invention, the
7   digital copying machine is modified to unscramble the
8   contents of the hard copy document which is stored in
9   its memory in accordance with a predetermined
10   unscrambling protocol, an example of which will be
11   described hereinbelow, and which is the inverse of the
12   scrambling protocol used to scramble the document.
13   It will be appreciated that preferably the
14   scrambling copier 15 and the unscrambling copier 20 are
15   respectively capable of scrambling and unscrambling a
16   document in a multiplicity of different ways, which are
17   selected by the input of a given code to the copier.
18   The scrambling and unscrambling codes may need to be
19   known to both the transmitter or recipient and may be
20   configured in accordance with any suitable known
21   scrambling and encryption technique. Alternatively, if
22   a public key is used, the recipient need not know the
23   scrambling code.
24   Fig. 2 graphically illustrates a dual paper
25   flow path in a typical office environment in accordance
26   with the present invention. A regular document 50 is
27   dealt with in an entirely normal way in all normal
28   office procedures, such as copying, faxing, mailing and
29   filing. If such a document is desired to be maintained
30   confidential, it is copied on a scrambling copier, such
31   as an enciphering copier and is thus converted into an
32   enciphered document 60 which cannot normally be read by
33   a person. This enciphered document can be dealt with in
34   all office procedures identically to the regular
35   document, but cannot be read by unauthorized persons.
36   An authorized person receiving the enciphered
37   document 60 and being in possession of an appropriate
38   unscrambling code may readily copy the enciphered

1   document 60 on an unscrambling copier 20, which may or
2   may not be the same copier as scrambling copier 15 and
3   may be remotely located therefrom. All that is required
4   is that the unscrambling copier 20 operate in an
5   inverse manner to the operation of scrambling copier
6   15. The result of unscrambling is a regular document,
7   which may be entirely identical to original regular
8   document 50 or may contain some indicia to indicate
.9 that it has undergone enciphering and deciphering.
10   In certain operations copiers 15 and 20
11 operate on fixed scrambling and unscrambling protocols
12 and thus do not require the application of scrambling
13 and unscrambling codes. Alternatively and preferably,
14 the copiers 15 and 20 are capable of operation in a
15 multiplicity of different scrambling and unscrambling
16 modes of operation, which are selectable by appropriate
17 codes.
18   In accordance with one embodiment of the
19 invention, the unscrambling code, or part thereof   may
20 be carried by the document itself and may be readable
21 by   the unscrambling copier. Any   other   suitable
22 technique of transmitting unscrambling code information
23 may alternatively be employed.
24   Reference is now made to Fig. 3, which
25 illustrates the general structure of the scrambling and
26 unscrambling copiers 15 and 20. In each case, the
27 copier comprises a document scanning unit 70 which
28 outputs to a memory 72 which is interactively connected
29 with an enciphering or deciphering program 74, as
30 appropriate, which is typically embodied on a VLSI chip
31 and which outputs to a printing unit 76.
32   At the scrambling or enciphering end, a human
33 readable document is scanned by the scanning unit 70
34 and an enciphered document is produced by the printing
35 unit 76. An enciphering key is provided to   the
36 enciphering program 74 for this purpose. At   the
37 unscrambling or deciphering end, a scrambled document
38 is scanned by the scanning unit 70 and a deciphered

1 document is produced by the printing unit 76. A
2 deciphering key is provided to the deciphering program
3 74 for this purpose.

4   Fig. 4 illustrates a typical scrambling
5 transformation wherein a multiplicity of multipixel
6 areas 80, here termed "gixels", are transformed from
7 their original relative spatial orientation on a human
8 readable document 82 to a different, scrambled,
9 relative spatial orientation on a scrambled document
10 84. The contours of the gixels are indicated herein as
11 dotted lines, it being appreciated that such dotted
12 lines do not have to appear on either the original or
13 scrambled document. It is appreciated that within each
14 gixel, the pixel arrangement is unscrambled.

15   Preferably the size of the gixel can be
16 selected by the user. Larger gixels provide a more
17 readable scrambled document, thus enabling faster
18 processing. Small gixels provide a more scrambled
19 document which is harder to read, but requires more
20 processing time. The minimum gixel size is a single
21 pixel. Information regarding the gixel size can be
22 incorporated as part of the scrambling code, or
23 alternatively it may appear on an unscrambled part of
24 the document or be ascertained empirically by an
25 examination of a scrambled document.

26   Arrows 90 indicate a typical spatial
27 transformation, it being appreciated that any suitable
28 spatial transformation may alternatively be provided.

29   Preferably part of the document area is not
30 scrambled. The unscrambled area normally contains
31 information that is intended to be readable by all
32 persons, such as the date, addressee, identification of
33 the sender, company logo and general instructions on
34 how to unscramble the document. The non-scrambled area
35 may include a heading portion, as well as a peripheral
36 edge strip 88, as seen in Fig. 4. The peripheral edge
37 strip 88 may provide a registration frame.
38 Alternatively, any other suitable registration marks

1 may alternatively or additionally be provided.It is
2 appreciated that the registration frame or other
3 registration marks do not normally appear on the
4 original document, but rather are added to the
5 scrambled document by the scrambling program and
6 removed by the unscrambling program.

7   In accordance with a preferred embodiment of
8 the present invention, verification of correct
9 scrambling and descrambling is provided by the
10 scrambling and unscrambling copiers. As illustrated in
11 Fig. 5, such verification can readily be performed by
12 considering the edges of adjacent gixels to confirm
13 matching between light and dark regions thereon.
14 Conventional spatial correlation techniques may be
15 employed for this purpose.

16   As seen in Fig. 5, the adjacent edges of two
17 adjacent gixels 92 and 94, indicated respectively by
18 reference numerals 96 and 98, are seen to have
19 identical or nearly identical patterns.

20   A   computer   program   for   scrambling,
21 descrambling and verifying correct descrambling appears
22 in Appendix A. This computer program can readily be
23 incorporated in conventional digital photocopiers such
24 as those mentioned hereinabove.

25   It will be appreciated by persons skilled in
26 the art that the present invention is not limited by
27 what has been particularly shown and described
28 hereinabove. Rather the scope of the present invention
29 is defined only by the claims which follow:
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'PROGRAM TO DEMONSTRATE SCRAMBLING, UNSCRAMBLING
'AND VALIDATION.
'THE PROGRAMS CREATES AN ARBITRARY INPUT IMAGE,
'CREATES A SCRAMBLING TABLE USING AN ARBITRARY
'SCRAMBLING CODE, AND THEN SCRAMBLES THE INPUT
'(LEFT SIDE) IMAGE INTO A SCRAMBLED (RIGHT SIDE)
'IMAGE. THEN THE PROGRAM ASKS THE USER TO
'SUGGEST AN UNSCRAMBLING CODE, AND TRIES TO
'RECONSTRUCT THE INPUT IMAGE USING THIS CODE.
'THE RESULT IS DISPLAYED ON THE LEFT SIDE,
'INSTEAD OF THE INPUT IMAGE. THEN THE PROGRAM
'CLACULATES A MEASURE OF THE QUALITY OF THE
'UNSCRAMBLING, AND PRINTS IT ON THE TOP-RIGHT
'CORNER OF THE SCREEN. THEN THE PROGRAM ALLOWS
'THE USER TO TRY A DIFFERENT UNSCRAMBLING CODE.

SCREEN 9: 'THIS VERSION IS WRITTEN IN BASIC, FOR
     A VGA SCREEN
DIM TXT$(20)
DATA "+---------------------------+"
DATA ": THIS PAGE WILL BE DECODED :"
DATA ":    BY SHUFFLING IT AFTER   :"
DATA ":          SEGEMNTATION      :"
DATA "+---------------------------+"
FOR I = 1 TO 5: 'THIS TEXT WILL BE USED AS A
PART OF THE SAMPLE DOCUMENT
READ TXT$(I)
NEXT
DIM DI(120, 80), DJ(120, 80), BOX(6000),
EMP(6000), B(10), C(10)
FOR I = 0 TO 1: 'THESE ARE TWO RECTANGLES TO
     FRAME ORIGINAL & SCRAMBLED DOCS.
LINE (9 + 300 * I, 19)-(301 + 300 * I, 350),
     15, B
LINE (10 + 300 * I, 20)-(300 + 300 * I, 349),
     2 + I, BF
NEXT
PSET (150, 200): 'THIS POLYLINE WILL BE A PART
     OF THE GRAPHICS ON THE INPUT SAMPLE
FOR I = 1 TO 25
X = 12 + RND * 276: Y = 22 + RND * 325:
     LINE -(X, Y)
NEXT
FOR I = 1 TO 10: 'THESE RINGS WILL BE PART OF
     THE GRAPHICS ON THE INPUT SAMPLE
CIRCLE (150, 110), 120 - 8 * I, 1
PAINT (150, 100), 4 + I, 1
NEXT
LINE (130, 90)-(170, 130), 0, BF
FOR N = 19 TO 23: 'PRINTING THE TEXT ON THE
     SAMPLE DOCUMENT
LOCATE N, 7: PRINT TXT$(N - 18)
NEXT
LOCATE 1, 6
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' THE BASIC TILE IS 5X7 PIXELS. IMAGE SIZE IS
      290X349 PIXELS (58X47 TILES)
HH = 58: VV = 47: 'HH AND VV ARE HORISONTAL AND
      VERTICAL TILE RESOLUTIONS
PRINT "CALCULATING A SHUFLING TABLE ("; HH;
      " X "; VV; ") GRID"
5000 : CODX = 43: CODY = 41: 'CODX AND CODY ARE
      THE SECRET SCRAMBLING CODES
'THE CODE TO BE ENTERED IS "4341". THE USER CAN
'CHANGE THE CODE BY CHANGING THE TWO NUMBERS IN
'LINE 5000. CODES THAT WORK NICELY: 47/41, 53/37
NCODX = CODX: NCODY = CODY: 'NCODX AND NCODY ARE
      TEMPORARY SHUFLING COUNTERS
' THE FOLLOWING LOOP PREPARES A SIMPLE
      SCRAMBLING TABLE BY ASSIGNING EVERY TILE
' OF THE INPUT IMAGE TO A UNIQUE TILE IN THE
      SCRAMBLED IMAGE, USING "MOD".
FOR I = 1 TO HH
FOR J = 1 TO VV
DI(I, J) = NCODX: DJ(I, J) = NCODY
NCODX = (NCODX + CODX) MOD (HH): NCODY =
      (NCODY + CODY) MOD (VV)
NEXT
NEXT
LOCATE 3, 42
PRINT "HIT ANY KEY TO START ENCIPHERING"
200 IF INKEY$ = "" THEN GOTO 200
LOCATE 1, 6: PRINT "
LOCATE 1, 41: PRINT "SCRAMBLING:"
LINE (309, 19)-(601, 350), 3, BF: HC = 290 / HH:
      VC = 329 / VV
FOR I = 1 TO HH: 'SCRAMBLING THE TILES ACCORDING
      TO THE SCRAMBLING TABLE
FOR J = 1 TO VV
XSTRT = 10 + (I - 1) * HC: YSTRT = 20 + (J - 1)
      * VC
GET (XSTRT, YSTRT)-(XSTRT + HC - 1, YSTRT +
      VC - 1), BOX
XPUT = 310 + (DI(I, J)) * HC: YPUT = 20 +
      (DJ(I, J)) * VC
PUT (XPUT, YPUT), BOX, PSET
NEXT
NEXT
600 ' INITIATE UNSCRAMBLING
LOCATE 1, 3: PRINT "                              "
LOCATE 1, 3: INPUT "  SECRET UNSCRAMBLING CODE
      (4 DIGITS): "; CODE
LOCATE 1, 3:
PRINT "PREPARING AN UNSCRAMBLING TABLE FOR";
      CODE; "      "
'PREPARING A TENTATIVE SCRAMBLING TABLE FOR THE
'SUGGESTED CODE. IF THIS IS NOT THE RIGHT CODE,
'THE UNSCRAMBLING WILL NOT RECONSTRUCT THE
'ORIGINAL IMAGE
CODX = INT(CODE / 100): CODY = CODE - 100 * CODX
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NCODX = CODX: NCODY = CODY
FOR I = 1 TO HH
FOR J = 1 TO VV
DI(I, J) = NCODX: DJ(I, J) = NCODY
NCODX = (NCODX + CODX) MOD (HH): NCODY =
      (NCODY + CODY) MOD (VV)
NEXT
NEXT
LOCATE 1, 3
PRINT "UNSCRAMBLING                            "
LOCATE 1, 75: PRINT "WAIT"
LINE (9, 19)-(301, 350), 1, BF: 'CLEARING THE
      LEFT PAGE FOR RECONSTRUCTION
FOR I = 1 TO HH
FOR J = 1 TO VV
' RECONSTRUCTING THE INPUT IMAGE BY TRANSFERRING
      TILES FROM THE SCRAMBLED IMAGE
' ACCORDING TO THE NEW UNSCRAMBLING TABLE
XSTRT = 310 + (DI(I, J)) * HC: YSTRT = 20 +
      (DJ(I, J)) * VC
GET (XSTRT, YSTRT)-(XSTRT + HC - 1, YSTRT +
      VC - 1), BOX
XPUT = 10 + (I - 1) * HC: YPUT = 20 + (J - 1)
      * VC
PUT (XPUT, YPUT), BOX, PSET
NEXT
NEXT
'CHECKING VALIDITY OF THE UNSCRAMBLED IMAGE
GET (10, 20)-(11, 349), BOX: Q = 0
LOCATE 1, 60: PRINT "QUALITY CHECK: "
LOCATE 1, 3: PRINT "VALIDATING:       "
D = 0
'THE QUALITY OF THE IMAGE IS CHECKED BY
'CORRELATING THE IMAGE ACROSS LIMITS BETWEEN
'TILES. EVERY INSTANCE OF EQUAL COLOR ACROSS
'BORDERS (IF NOT ZERO) ADDS TO THE QUALITY MARK D.
FOR I = 1 TO HH STEP 5
XPUT = 10 + (I - 1) * HC
FOR J = 1 TO 340 STEP 5
GET (XPUT + HC - 1, 20 + J)-(XPUT + HC, 21
      + J), B
GET (XPUT + HC, 20 + J)-(XPUT + HC + 1, 21
      + J), C
'PRINT B(1), C(1)
IF C(1) = B(1) AND C(1) <> 0 THEN D = D + 1
NEXT J
LOCATE 1, 20: PRINT INT(100 * I / HH); "%";
NEXT I
LOCATE 1, 75: PRINT D - 470
GOTO 600
END
```

1
2   C L A I M S
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4
5   1.   Apparatus   for   scrambling   documents
6   comprising:
7   an output signal generator providing output
8   signals representing the contents of a document;
9   a scrambler operating on the output signals
10 to produce modified output signals representing a
11 scrambled version of the document; and
12   a scrambled document writer receiving said
13 modified output signals and producing a scrambled
14 version of the document.
15
16 2.   Apparatus according to claim 1 and wherein
17 said scrambler is controlled by a coded input to
18 provide a selected one from a plurality of possible
19 modifications to the output signals.
20
21 3.   Apparatus according to any of the preceding
22 claims when embodied in a photocopier.
23
24 4.   Apparatus according to any of the preceding
25 claims 1 - 2 when embodied in a telefax.
26
27 5.   Apparatus according to any of the preceding
28 claims when embodied in a computer.
29
30 6.   Apparatus according to any of the preceding
31 claims and wherein said scrambler is operative to
32 change the relative positions of multi-pixel regions of
33 a document, without modifying the information content
34 within each of the multi-pixel regions.
35
36 7.   Apparatus according to any of the preceding
37 claims and wherein said scrambler is operative to leave
38 unchanged   certain   predetermined   regions   of   the

1   document.

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3   8.   Apparatus according to any of the preceding

4   claims   and   wherein   said   output   signal   generator

5   comprises   a   scanner   receiving   a   document   to   be

6   scrambled and providing output signals representing the

7   contents of the document.

8

9   9.   Apparatus   for   unscrambling   documents

10 comprising:

11   a   scanner   receiving   a   document   to   be

12 unscrambled   and providing output signals   representing

13 the contents of the document;

14   an   unscrambler for operating on   the   output

15 signals to produce modified output signals representing

16 a unscrambled version of the document; and

17   an unscrambled document writer receiving said

18 modified   output   signals and producing   a   unscrambled

19 version of the document.

20

21 10.   Apparatus   according   to   claim   9   and   also

22 comprising an unscrambling verifier for verification of

23 correct unscrambling.

24

25 11.   Apparatus   according to claim 10 and   wherein

26 said   unscrambling   verifier   receives   and   employs   a

27 registration frame on the document.

28

29 12.   Apparatus   according to claim 10 and   wherein

30 said unscrambling verifier comprises an edge correlator

31 for   carrying   out   edge   correlation   operations   on

32 adjacent scrambled pixels.

33

34 13.   Apparatus   according to claim 9   and   wherein

35 said   unscrambler   is controlled by a   coded   input   to

36 provide   a   selected one from a plurality   of   possible

37 modifications to the output signals.

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1 14.   Apparatus according to any of the preceding
2 claims 9 - 13 when embodied in a photocopier.
3
4 15.   Apparatus according to any of the preceding
5 claims 9 - 13 when embodied in a telefax.
6
7 16.   Apparatus according to any of the preceding
8 claims 9 - 13 when embodied in a computer.
9
10 17.   Apparatus according to any of the preceding
11 claims and wherein said scrambler is operative to
12 change the relative positions of multi-pixel regions of
13 a document, without modifying the information content
14 within each of the multi-pixel regions.
15
16 18.   Apparatus according to claim 9 and wherein
17 said unscrambler is operative to change the relative
18 positions of multi-pixel regions of a document, without
19 modifying the information content within each of the
20 multi-pixel regions.
21
22 19.   Apparatus according to claim 9 and wherein
23 said unscrambler is operative to leave unchanged
24 certain predetermined regions of the document.
25
26 20.   Apparatus for scrambling documents for use in
27 conjunction with a document writer and an output signal
28 generator providing output signals representing the
29 contents of a document, the apparatus comprising:
30   a scrambler operating on the output signals
31 to produce modified output signals representing a
32 scrambled version of the document and to provide the
33 modified output signals to the scrambled document
34 writer, for writing of a scrambled version of the
35 document.
36
37 21.   Apparatus for unscrambling documents for use
38 in conjunction with a document writer and a scanner

1 receiving a document to be unscrambled and providing
2 output   signals representing the contents of   the
3 document, the apparatus comprising:
4   an   unscrambler operating on the   output
5 signals to produce modified output signals representing
6 a unscrambled version of the document and to provide
7 the modified output signals to the document writer, for
8 producing an unscrambled version of the document.
9 22.   A method for scrambling documents for use in
10 conjunction with a document writer and an output signal
11 generator providing output signals representing the
12 contents of a document, the method comprising the steps
13 of:
14   operating on the output signals to produce
15 modified   output signals representing a   scrambled
16 version of the document and to provide the modified
17 output signals to the scrambled document writer, for
18 writing of a scrambled version of the document.
19
20 23.   A method for unscrambling documents for use
21 in conjunction with a document writer and a scanner
22 receiving a document to be unscrambled and providing
23 output   signals representing the contents of   the
24 document, the method comprising the steps of:
25   operating on the output signals to produce
26 modified output signals representing a unscrambled
27 version of the document and to provide the modified
28 output signals to the document writer, for producing an
29 unscrambled version of the document.
30
31 24.   A method for scrambling documents comprising:
32   providing output signals representing the
33 contents of a document;
34   operating on the output signals to produce
35 modified   output signals representing a   scrambled
36 version of the. document; and
37   receiving said modified output signals and
38 producing a scrambled version of the document.

1   25.   A method for unscrambling documents
2   comprising the steps of:
3   receiving a document to be unscrambled and
4   providing output signals representing the contents of
5   the document;
6   operating on the output signals to produce
7   modified output signals representing a unscrambled
8   version of the document; and
9   receiving said modified output signals and
10   producing a unscrambled version of the document.
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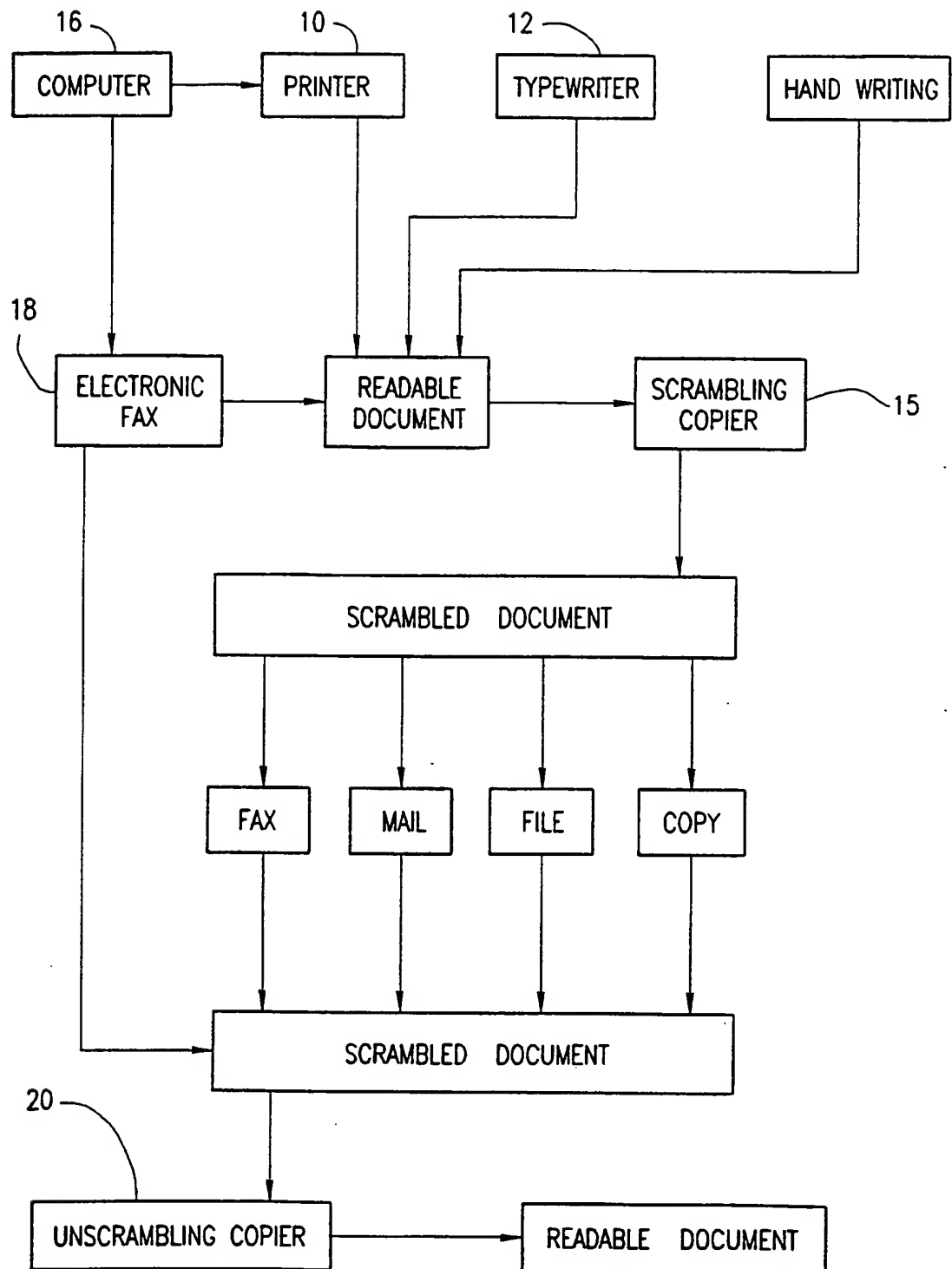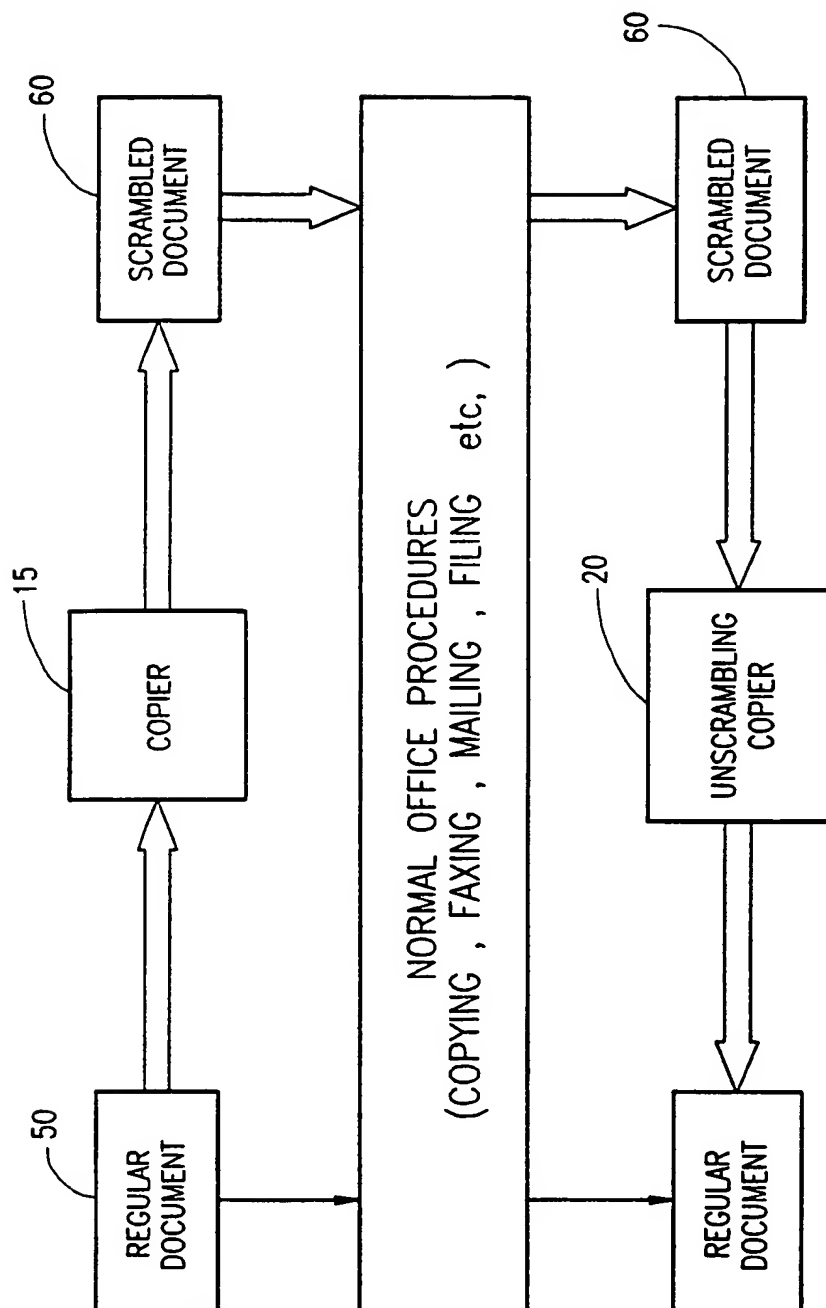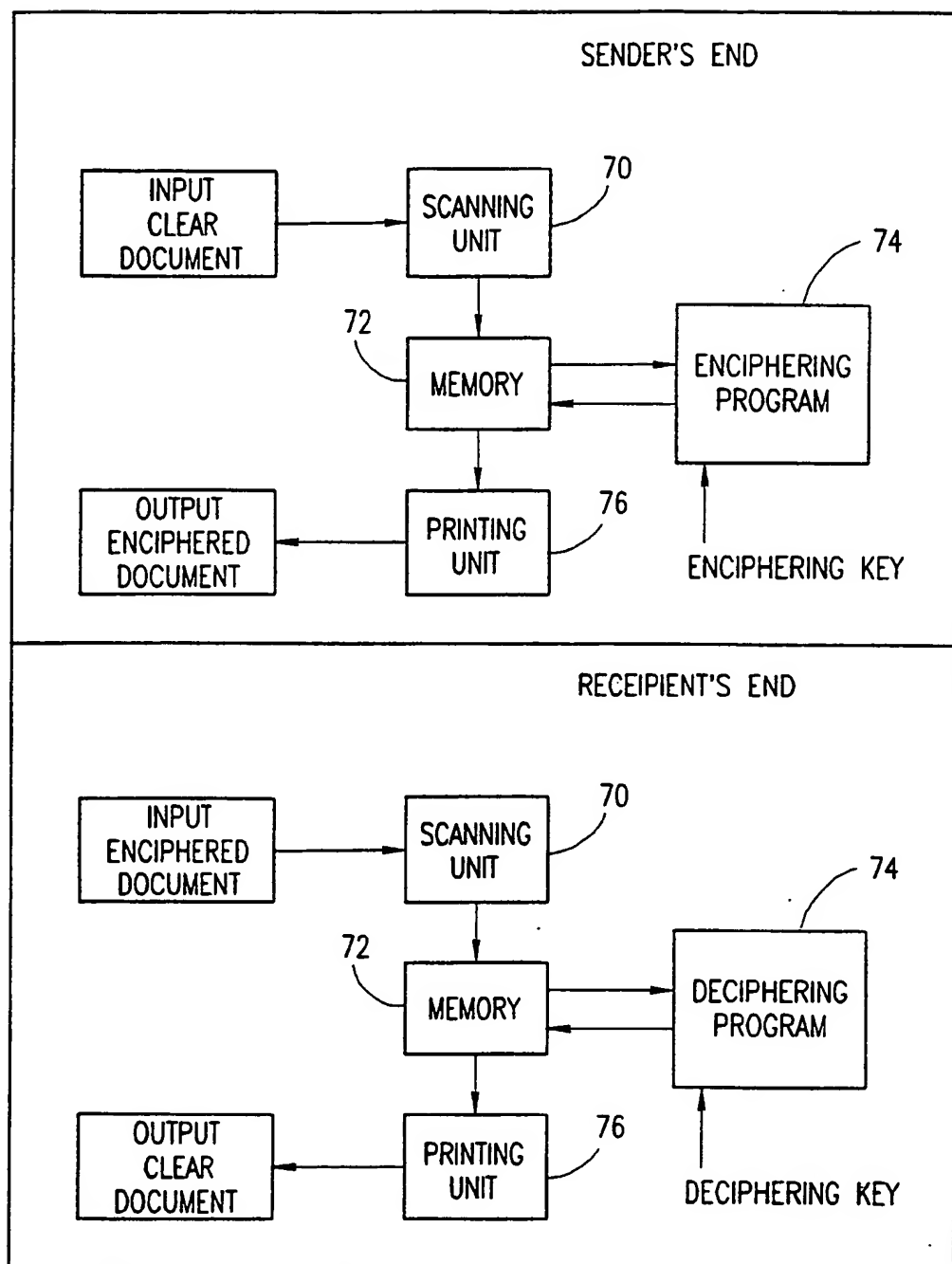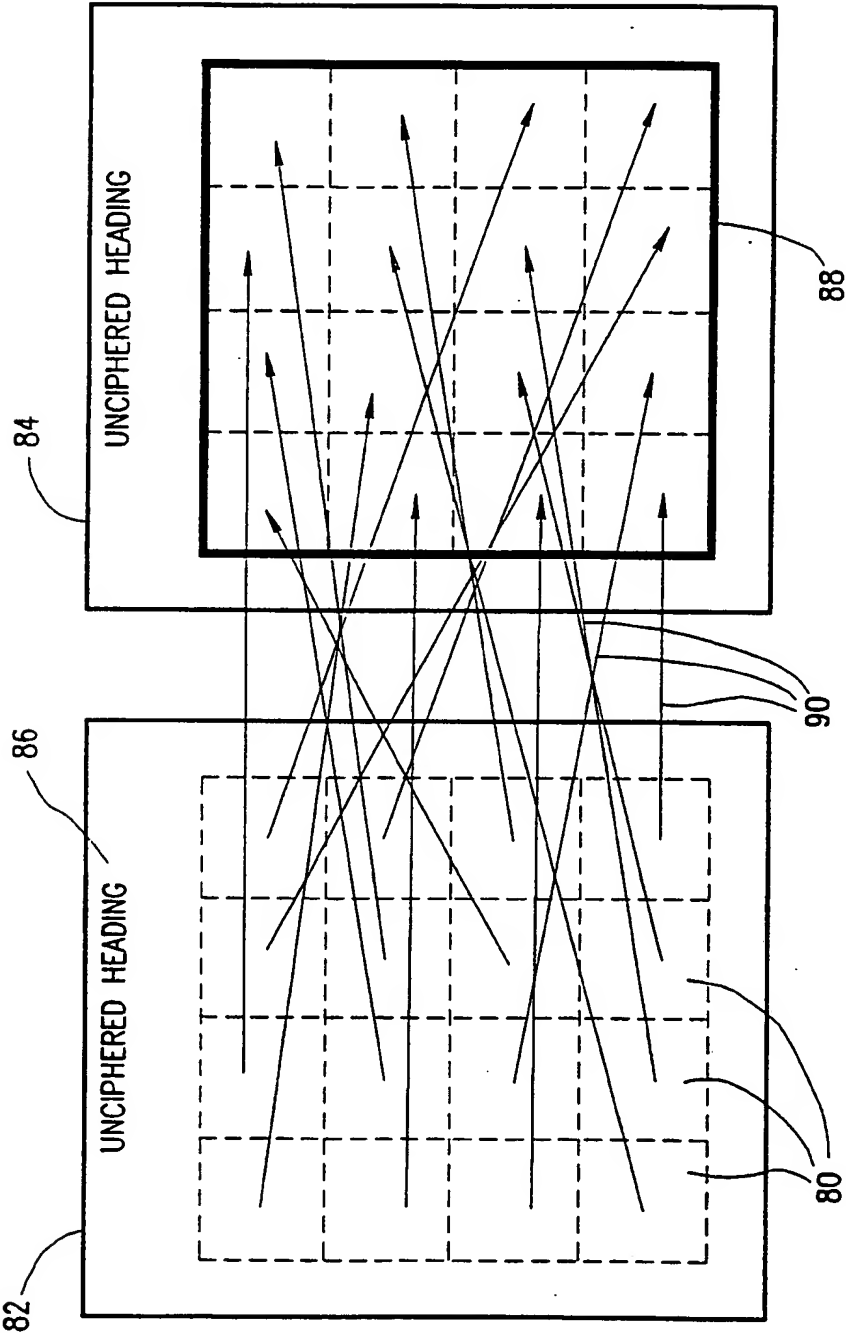29
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FIG.1

FIG.2
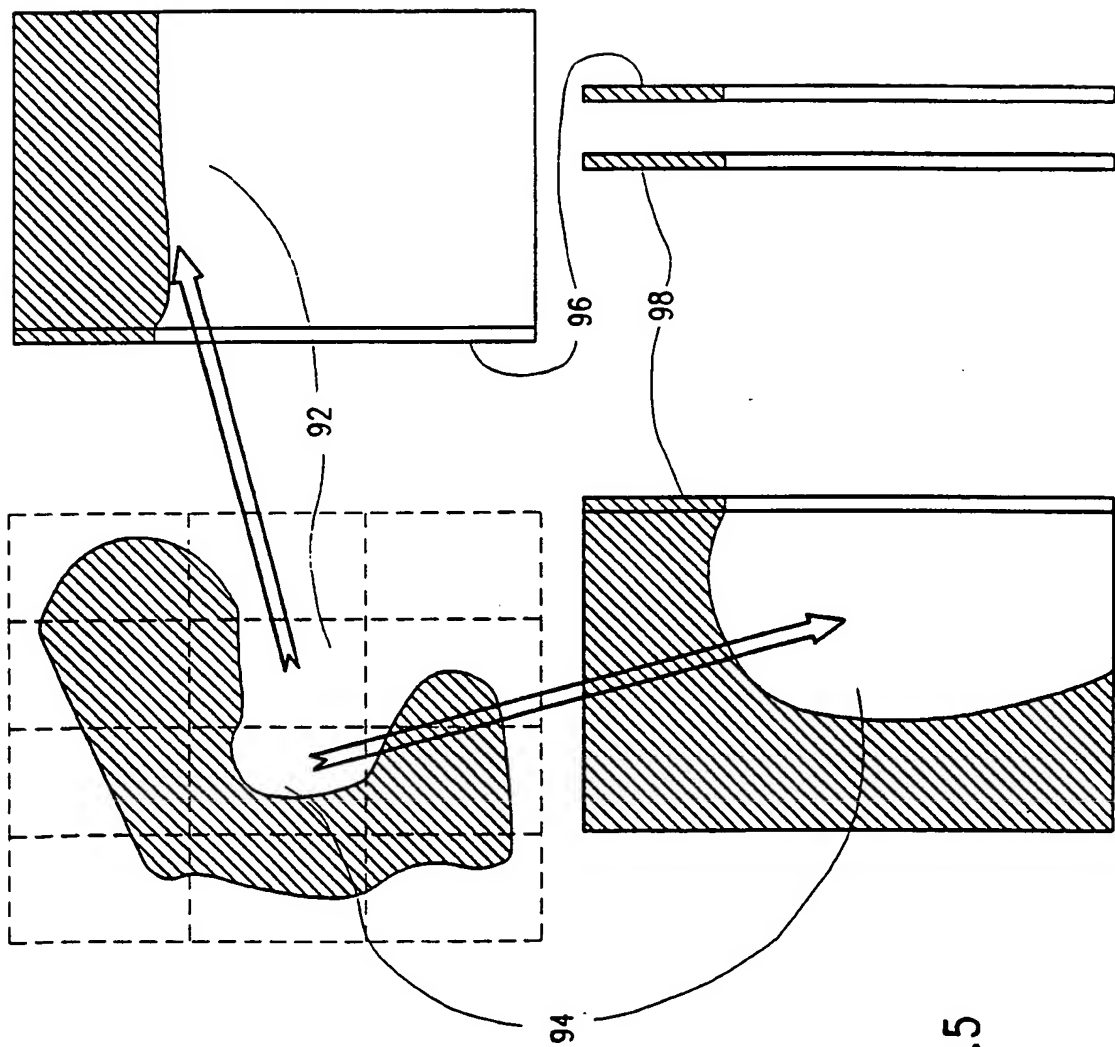
SENDER'S END

INPUT CLEAR DOCUMENT → SCANNING UNIT *70*

SCANNING UNIT → MEMORY *72*

74 ENCIPHERING PROGRAM

MEMORY ↔ ENCIPHERING PROGRAM

ENCIPHERING KEY → ENCIPHERING PROGRAM

MEMORY → PRINTING UNIT *76* → OUTPUT ENCIPHERED DOCUMENT

RECEIPIENT'S END

INPUT ENCIPHERED DOCUMENT → SCANNING UNIT *70*

SCANNING UNIT → MEMORY *72*

74 DECIPHERING PROGRAM

MEMORY ↔ DECIPHERING PROGRAM

DECIPHERING KEY → DECIPHERING PROGRAM

MEMORY → PRINTING UNIT *76* → OUTPUT CLEAR DOCUMENT

FIG.3

FIG.4

FIG.5

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INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) : G09C 3/08, 5/00; H04L 15/34; H04N 1/44

US CL :380/51,55,18,54

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 380/9,49

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A, 4,459,611 (Arai et al.) 10 July 1984. See column 3, line 12 thru column 5, line 19. Also col. 2, lines 10-14.	1-9 and 13-25
Y	US,A, 5,027,401 (Soltesz) 25 June 1991 See Fig. 6 and col. 6, line 43-59.	10,11
Y	US,A, 4,091,423 (Branscome) 23 May 1978 Fig. 1.	4,5
A	US,A, 4,989,244 (Narvse et al.) 29 January 1991.	1-9 and 13-25
A	US,A, 5,062,136 (Gattis et al) 29 October 1991.	1-9 and 13-25

☐ Further documents are listed in the continuation of Box C.   ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance		
"E"	earlier document published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)		
		"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed	"&"	document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 APRIL 1993	22 APR 1993

Name and mailing address of the ISA/US	Authorized officer
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